ELECTRICAL APPRENTICESHIP CURRICULUM OUTLINE FY2012 YEAR 3

Electrical Training: **162 hours**

First Semester & Yearly Final Exams: **6 hours**

Total Hours: **168 hours**

Each of the following subjects may take more or less time than is shown, but a minimum of 144 hours is required. The instructor should concentrate on the student achieving the basic objectives stated.

Recommended Textbooks for PTE Schools:

***Electrical Wiring Commercial*, ISBN 978-1-4354-9829-7**
***Electricians Exam Prep*, ISBN 978-0-7637-5118-0**
National Electrical Code (NEC)
***Ugly's Electrical Safety and 70E*, ISBN 978-0-7637-6855-3**
***Ugly's Electrical Reference*, ISBN 978-0-7637-9099-8**

Note: An *asterisk indicates "green" attributes in the studies

Safety and NFPA70E

Incorporate discussions and test questions based on electrical safety and NFPA 70E in the following areas of study as is appropriate. This is an extension of the basic safety introduced in year one.

Commercial Building Plans and Specifications

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Review and discuss a review of basic safety rules for electrical systems
- Define the project requirements from the contract documents
- Demonstrate the application of building plans and specifications
- Locate specific information on building plans
- Obtain information from industry-related organizations
- Apply and interchange International System of Units (SI) and English measurements

Reading Working Drawings

(Use any set of commercial prints for classroom training along with text)

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Read and interpret electrical symbols used in construction drawings
- Identify the electrical installation requirements for a building
- Determine elevations
- Determine the installation spaces of all other trades
- Determine construction materials, measurements, and specifications

Calculating the Electrical Load

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Determine the minimum lighting load for a given area
- Determine the receptacle load for a given area
- Determine Equipment loads
- Determine a reasonable calculated load
- Apply the factors for continuous loads
- Apply the factors for non-coincident loads

Branch Circuits

Objectives: 6 hours (review and reinforcement from previous years)

At the completion of this lesson the student should be able to:

- Determine the required number of branch circuits for a set of loads
- Apply adjustment and correction factors
- Apply factors for continuous, motor, and heating loads
- Determine correct rating for branch circuit protective devices
- Determine appropriate wire type
- Determine the proper size
- Explain the heating effect of magnetic flux and how to properly wire to cancel it.

Switches and Receptacles

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Discuss the various NEMA configurations for receptacles
- Select the proper receptacle for use in hospitals, electronic equipment installations, and ground isolation
- Determine the proper use of switches based on rating and terminations
- Properly use color coding for electrical installations

Cooking Equipment (Based on Exam Prep)
Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Calculate dwelling range loads of the same ratings
- Calculate dwelling range loads of different ratings
- Calculate demand loads for cooking equipment
- Calculate loads for commercial kitchen equipment
- Calculate loads for clothes dryers using the standard method
- Calculate loads for clothes dryers using the optional method
- Calculate neutral loads for cooking equipment and clothes dryers

Commercial Calculations (Based on Exam Prep)
Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Calculate a commercial electrical service load using the standard calculation method of article 220
- Calculate a commercial electrical service load using the optional calculation method of article 220

Wiring Methods (Review and reinforcement from previous years)
Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Select the proper raceway of cable for the conditions
- Identify the installation requirements for a raceway of cable
- Select the proper raceway size, depending on the conductors to be installed
- Properly size outlet, pull, and junction boxes

Motor and Appliance Circuits (Review and reinforcement from previous year)
Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Use and interpret the word *appliance*
- Use and interpret the term *utilization equipment*
- Properly wire and properly install disconnecting means for appliances and motors
- Understand the term *Type 1* and *Type 2* protection
- Define *single phasing*
- Design a motor circuit: calculate proper wire size, overcurrent protection, overload size, disconnect size, feeder size for several motors, feeder overcurrent protection

Feeders
Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Calculate feeder loading

- Calculate the feeder overcurrent device
- Calculate the proper feeder size for any combination of loads
- Calculate correction factors
- Calculate voltage drop
- Calculate the reduced neutral size as is appropriate
- Determine raceway size

Special Systems

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Select and install multi-outlet assemblies
- Calculate the load allowance for multi-outlet assemblies
- Select and install a floor outlet system
- Determine proper wiring for fire alarm installations

Working Drawings-Upper Level

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Tabulate materials required to install an electrical rough-in
- Select the components to install large equipment such as commercial water heaters, heating, cooling, etc.
- Explain the advantages and disadvantages between single-phase and three-phase systems

Special Circuits

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Describe typical connection schemes for photocells and timers
- Determine the requirements for wiring an elevator
- Properly connect the controls for a sump pump

***Lamps and Ballast for Lighting**

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Understand the technical terms for associated with lamps and ballast
- Identify lamps scheduled to be used in a commercial building
- Understand the basics of incandescent, halogen, fluorescent, LED, and HID lamps
- Understand the practical application of lamps used in a commercial building
- Understand more about energy savings for lamps and ballasts
- Identify lamp types according to characteristics and letter designations
- Be aware of the hazards of disposing lamps and ballasts

***Luminaires**

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Locate luminaires in a space
- Properly select and install luminaires

- Discuss the attributes of different types of luminaires
- Exercise some control over energy savings by giving proper advice

Overcurrent Protection: Fuses and Circuit Breakers

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- List and identify the types, classes, and ratings of fuses and circuit breakers
- Describe the operation of fuses and circuit breakers
- Develop an understanding of switch sizes, ratings, and requirements
- Define *interrupting rating, short-circuit currents, RMS, and current limitation*
- Use let-through charts

Short-Circuit Calculations and Coordination of Overcurrent Protective Devices

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Perform Short-circuit calculations using the point-to-point method
- Calculate short-circuit currents using the appropriate tables and charts
- Define the terms *coordination, selective systems, and non-selective systems*

***Commercial Utility Interactive Photovoltaic Systems**

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- List the components of a utility interactive solar photovoltaic system
- Describe the function of a utility interactive solar photovoltaic system and components
- Apply the NEC to the design and installation of commercial utility interactive solar photovoltaic system and components
- Interpret a typical utility interactive solar photovoltaic system single line drawing

Basic Principles of Motor Controls

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Recognize ladder diagrams
- Recognize connection diagrams
- Recognize pictorial diagrams
- Use and interpret definitions, abbreviations, and graphic symbols used on motor control diagrams
- Describe the function of pushbutton stations, solenoids, flow switches, pressure switches, limit switches, and timing relays

Components of Control Circuit Schematics, Magnetic Control

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Use a ladder diagram to illustrate a simple two wire control circuit for a single-phase motor operated by a float switch or similar device
- Use a ladder diagram to illustrate a simple start/stop station operating a motor starter
- Identify circuit types classified by power source—common control circuits, transformer control wiring, and separate control wiring

- Identify control devices and their function
- Identify remote-control circuits and their function
- Use 120 volt control circuit to operate a 480 volt load
- Explain the operation and use of magnetic motor starters

Basic Control Circuits, Overcurrent Protection for Control Circuits

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Design both two-wire and three-wire controls using start/stop stations and other devices such as float switches
- Design a circuit operating a motor starter using two or more start/stop stations
- Use the NEC to properly protect control circuits to include conductor sizes, overcurrent protection, and control transformers

Indicator Lights and Illuminated Pushbuttons, Selector Switch Truth Tables

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Understand the use of illumination in motor controls
- Interpret symbols used on diagrams
- Read truth tables
- Diagram the use of a selector switch on a three-wire control for a jogging application

Reversing Controls for Three-Phase Motors, Reversing Controls with Indicator Lights for Three-Phase Motors, Reversing Controls with Limit Switches for Three-Phase Motors, Reversing Single Phase Motors

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Diagram the operation of a reversing starter
- Diagram the operation of a reversing control station
- Diagram the operation of a reversing control selector switch
- Apply functional indicator lights to reversing controls
- Diagram a limit switch to automatically stop a motor
- Diagram reversing operations using limit switches
- Diagram the operation of a garage door
- Diagram the operation of reversing a single-phase motor

Sequencing Control and Master Stop Function, Introduction to Variable Frequency Drives

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Interpret a diagram showing the sequencing of several motors
- Apply the master stop function to and process using motor controls
- Explain the basic operation of variable frequency drives

Panelboard selection and Installation

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Identify the criteria for selecting a panelboard

- Correctly place and number circuits in a panelboard
- Calculate the proper feeder size for a panelboard
- Determine the correct overcurrent protection for a panelboard
- Prepare a panelboard directory

The Electric Service

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Install power transformers to meet NEC requirements
- Draw the basic transformer connection diagram
- Recognize different service types
- Define the various components of service equipment
- Correctly install service equipment
- Connect metering equipment
- Install the grounding system

Low Voltage Remote-Control

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Discuss the importance of energy savings and ways to accomplish it.
- List the components of a low-voltage remote-control wiring system
- Select the appropriate NEC sections governing the installation of a low-voltage remote-control wiring system
- Demonstrate the correct connections for wiring a low-voltage remote-control system

Cooling Systems

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- List the parts of a cooling system
- Describe the function of each part in a cooling system
- Calculate the sizes of the electrical components
- Read a typical wiring diagram that shows the operation of a cooling unit